

**Exploring the potential transition from strategic
technology partnering to mergers and acquisitions**

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This paper studies a number of research topics derived from the basic question: do inter-firm partnerships with different intermediary modes of company organization change over time as companies that were previously cooperating become integrated? The analysis is limited to the group of strategic technology alliances, i.e. those inter-firm agreements for which joint technology development or technology sharing is part of the agreement.

The paper first explores the literature that refers to the possible transition from strategic technology alliances to mergers and acquisitions. Based on this we formulate a number of hypotheses regarding the change in modes of governance and several dimensions of this process related to the size of firms, the international distribution, the distribution of contractual and equity agreements and the industry specificity. The major finding of our research is that the transformation from strategic technology alliance to merger and acquisition hardly ever takes place. This suggests that alliances and mergers and acquisitions are not part of a rather smooth continuum but they are first of all different modes of governance where one mode certainly does not lead to the other.

INTRODUCTION

This paper studies the transformation of strategic technology alliances into mergers and acquisitions (M&As) in the context of the well-known continuum that reaches from market transactions via the 'swollen middle' of hybrid modes of governance to integrated hierarchical structures (Hennart, 1993 and Williamson, 1991). Most of the research on these alternative modes of organization has concentrated on economic or strategic implications for firms regarding each of the segments of the continuum or the trade off in the choice between these alternatives. So far little empirical research has been performed that concerns the possible transition of different modes of company organization, e.g. the possible dynamic relationship between intermediary modes and hierarchies.

A small number of contributions, in particular in the strategic management literature, links up to the intuitive understanding of such a relationship stressing an 'encroachment' strategy followed by some companies. For instance Doz, Hamel and Prahalad (1986), Haspeslagh and Jemison (1991) and Reich and Mankin (1984) analyze such strategies in the context of firms that use their alliances as a vehicle to get greater control over their partners, whereby some of these partners are integrated after a period of 'courtship'. However, if we study the vast body of literature on strategic alliances, cooperative agreements and joint ventures that has emerged parallel to the rapid increase of these inter-firm agreements, we find only a limited number of examples where the encroachment thesis is empirically tested or theoretically further developed.

In the following we pay attention to a set of research questions related to the basic

question: do inter-firm partnerships with different intermediary modes of organization, such as contractual agreements and equity sharing agreements, change over time as companies, that were previously cooperating, become integrated? This question addresses the rather 'strong' variant in the transformation process where companies are merged or taken over instead of a transformation of an equity agreement in which one of the partners increases its share in the equity distribution of an alliance. Although equity agreements are still an important vehicle for inter-firm partnering, it has to be stressed that the majority of cooperative agreements made in recent years have become of a contractual nature. It is estimated that in the late eighties and early nineties about 75% of the strategic alliances are of a contractual nature without equity-sharing (Hagedoorn, 1996). Given this growing importance of contractual agreements it appears more interesting to study the possible transformation of alliances through an encroachment of partners than to concentrate on the 'weaker' variant, i.e. the increase of an equity-share within a joint venture.

Following the above-mentioned continuum our paper concentrates on the cooperation - integration related aspects of inter-firm relationships. More specifically we distinguish four different modes:

- contractual agreements, in particular joint R&D pacts and joint development agreements through which companies undertake innovative projects with shared resources
- joint ventures are combinations of the economic interests of at least two different companies in a 'distinct' firm which also performs R&D or undertakes innovative

projects

- takeovers or acquisitions where one company has obtained majority ownership over another company
- mergers refer to cases where two separate companies are combined into one company.

The first two modes are strategic alliances (Hagedoorn, 1993), the latter two are hierarchies in the classical sense of being modes of governance that are integrated into one company.

The above already indicates that we limit the group of strategic alliances to technology related partnerships, i.e. those inter-firm agreements for which joint technology development or technology sharing are part of the agreement. Although this has some obvious limitations, previous research, for instance Kogut (1991), mentions the particular role that technology related alliances can play in possible takeover activities. In that context a strategic alliance is applied by at least one of the partners to assess the strategic importance of the technology involved. After the decision to invest in a particular technology is delayed for some time or only partially made in order to assess the importance of that technology, the company decides whether it intends to increase its activities through an acquisition of the alliance or its partner. Furthermore, the particular strategic importance of technology for the future competitive strength of companies is a major reason why technology related alliances are an interesting subset of a wider range of cooperative agreements (Mowery, 1988; Mytelka, 1991).

In the following sections we will first explore the scattered pieces of literature that

refer to the possible transition from strategic technology alliances to M&As. Based on our understanding of the most crucial and relevant contributions we will formulate a number of hypotheses regarding the change from alliances into M&As in the light of several dimensions of this transformation such as the size of firms, the international distribution, the distribution of equity versus contractual modes, and the industry specificity. Due to the exploratory character of our investigation and the rather remarkable empirical finding regarding the actual significance of the encroachment strategy we will not attempt to first formulate an elaborate theoretical foundation. However, theoretical implications of our contribution will be discussed in the final section of the paper. Before we test several hypotheses we will pay attention to the data sets that are analyzed, the procedures used to link different data banks, and the description of the indicators as applied in this study. Finally, our conclusions set our contribution against the current understanding of different modes of governance and the particular place taken by strategic technology alliances. We will briefly discuss our main findings in terms of possible consequences for a theoretical understanding of strategic technology alliances as a distinct mode of organization.

EXPLORING THE CONTINUUM: PREVIOUS RESEARCH AND HYPOTHESES

Strategic alliances leading to M&As

As already mentioned above Doz, Hamel and Prahalad (1986) and Reich and Mankin (1984) mention that firms can use their strategic alliances to learn about the opportunity to achieve greater control over their partner in an acquisition. Kogut (1991) analyzes joint ventures, which we understand as a particular group of strategic alliances, as an option

for firms that can bridge two basic alternatives, i.e. to wait before one commits resources and to demonstrate strong commitment through investment. Joint ventures are then used to assess the opportunity of a new technology or new product. After the chances of future success have become more clear the option to acquire is likely to be exercised. Bowman and Hurry (1993) apply the idea of the 'option lens' to discuss the sequential choice in incremental options that allow companies to make a small investment, e.g. in a joint venture, and then to postpone for some time a more definite decision that would imply the striking of an option, e.g. through an acquisition. In a somewhat similar line of thought Haspeslagh and Jemison (1991) point at the possibilities offered by alliances to investigate takeover opportunities and to first encroach a partner before it is acquired. These authors conclude that "... in many cases collaboration is the first productive step (...) before complete acquisition, or to overcome a firm's reticence and open the way for a potential merger" (Haspeslagh and Jemison, 1991, p. 246). Also Hurry (1993) and Lynch (1989) point at the general advantages of incremental strategies through which, over time, cooperation leads to the acquisition of partners. Firms that are active in forming partnerships are expected to create alliances to learn about new opportunities or to use alliances as vehicles for acquisitions or divestiture. Following this line of inquiry, which points at the potential acquisition of one of the partners in an alliance, we introduce the following hypothesis:

1 *Strategic technology alliances lead to the formation of M&As, whereby*

participating companies are taken over or merged and the strategic technology alliance is transformed from shared to single ownership.

Our reading of the literature suggests that very little is known on the actual time-lag between establishing a strategic alliance or a joint venture and its possible acquisition. Kogut's (1988) study of nearly 150 joint ventures involving US firms shows that very few of them were acquired during the first year, during the following years about 25% of the joint ventures were acquired. Given this degree of ignorance regarding possible time-lags, we will not formulate a hypothesis on this topic but keep it as a question as to what time-lag can be reconstructed for strategic technology alliances that lead to M&As.

General conditions affecting the process of transformation

Most of the studies mentioned above understand strategic alliances in the context of a number of conditions that shape the outcome of partnering strategies. Ring and van de Ven (1992) discuss important dimensions that have to be taken into account such as market power differentials, domestic and international aspects, relational characteristics such as the mode of cooperation, and the industry specific context of partnering behaviour. In the following we will discuss the possible transition of strategic technology alliances in the light of each of these dimensions of partnering strategies.

Market power and size of firms

The analysis of the role that companies of different size classes might play in the transition of strategic technology alliances fits quite well within the more or less standard industrial organization inspired tradition within strategic management where the different roles of companies from different size categories is frequently explored further. In that context Hurry (1993) places part of his analysis of strategic partnering strategies in the context of the relationship between financially stronger and weaker firms. He expects stronger firms to take control over their alliances or acquire their weaker partners. Research by Berg, et al (1982), Hagedoorn and Schakenraad (1994) and Duysters and Hagedoorn (1995) suggests that larger firms are more active in partnering than their smaller competitors. The first mentioned contribution also hints at the possibility that in case of an unequal size distribution in a partnership, this alliance will probably be dissolved through a takeover. Taken together with the already mentioned encroachment thesis, we can interpret the relationship between size of companies and the transformation of strategic technology alliances in terms of a relationship between unequals, suggesting that:

- 2a *If the transformation from strategic technology alliances to M&As occurs, a disproportionate share of these cases of transformation is between companies of different size-classes.*

- 2b *After a period of courtship through strategic technology alliances, large firms acquire their smaller partners.*

Domestic versus international partnerships

Several recent contributions suggest that the domestic or international character of an alliance influences the particular organizational mode being chosen. Research by Gulati (1995) and Hagedoorn and Narula (1996) indicates that international alliances are more equity oriented whereas a disproportionate share of domestic alliances are of a contractual nature. From both a transaction cost economics perspective and a strategic management perspective this preference can be explained in terms of the cost of monitoring and keeping control over a long distance agreement. As domestic alliances are formed in a familiar environment, equity control is probably less prevalent in order to monitor the agreement than in the case of international alliances, where the familiarity with the behaviour of partners is expected to be smaller. Enforcing a contract in an unfamiliar environment is rather difficult compared to enforcing partial control through an alliance in which equity-sharing gives a firm at least some degree of ownership advantages (Dunning, 1993). An interesting question in that context is then whether the disproportionate equity orientation of international strategic technology alliances also implies that firms demonstrate a certain preference for increasing their control over their international partnerships through integration. Research by Longfellow Blodgett (1991) does suggest that international strategic technology alliances have a high chance of being discontinued through the acquisition of one of the partners in the alliance. Hence:

3 *If the transformation from strategic technology alliances to M&As occurs, the*

share of these M&As will be disproportionately higher for international strategic technology alliances than for domestic strategic technology alliances.

Differences between equity and non-equity-based agreements

The literature on strategic alliances and inter-firm cooperation suggests that different modes of cooperation, such as equity-sharing alliances (joint ventures) and contractual modes have a different impact on performance, organization, and management of partnering firms (Hagedoorn, 1993; Harrigan, 1985; Osborn and Baughn, 1990). Hagedoorn (1993) found joint ventures aimed at shared innovative efforts to be rather complex organizations with a multitude of company objectives, whereas contractual modes of technology partnering are more one-dimensionally oriented. The complexity of joint ventures seems to make these organizations vulnerable and prone to failure (Berg et al., 1982). Contractual technology partnering agreements, on the contrary, are more limited in scope, aimed at short-term technological achievement and fairly simple in terms of their organizational nature. Although there is, to the best of our knowledge, no literature analyzing the different options to acquire partners through contracts or joint ventures, we expect the likelihood of the creation of M&As through joint ventures to be higher than through contractual agreements. We already mentioned that research by Kogut (1991), Berg et al. (1982) and Longfellow Blodgett (1991) indicates that joint ventures can be part of a take over process. The multidimensional nature of joint ventures provides partners with a better understanding of the technological and commercial impact of the venture. Compared to joint ventures contractual agreements have a more limited

scope and are aimed at single projects that seem of much less relevance to a future takeover or merger activity which concerns a wider range of company activities. Therefore, we expect that joint ventures have a higher probability of leading to an M&A than contractual agreements. Hence:

4 *If the transformation from strategic technology alliances to M&As occurs, a disproportionate share of strategic technology alliances that are of an equity nature (joint ventures) will lead to an M&A transformation, whereas a disproportionate share of strategic technology alliances of a contractual nature will not be dissolved in M&As.*

Industry context

Contributions by Harrigan and Newman (1990) and Balakrishna and Koza (1993) suggest that joint ventures between companies from similar businesses have a higher probability of being dissolved than those made between companies from dissimilar industries. Hagedoorn (1993) discusses the importance of technological and market complementarity for understanding the motives of partners to engage in strategic technology alliances. Harrigan (1985), Mowery (1988) and Ohmae (1985) also indicate that complementarity is an essential characteristic for successfully maintaining a strategic alliance. This suggests that complementarity of partners, that are operating in dissimilar product-markets with probably little conflict of interests, increases the viability of the combined effort, whereas cooperation between companies with similar product-market combinations

and a higher probability of a conflict of interests is more likely to be resolved in an M&A.

Therefore:

- 5 *If the transformation from strategic technology alliances to M&As occurs, a disproportionate share of strategic technology alliances between companies from the same industry will lead to an M&A transformation, whereas a disproportionate share of strategic technology alliances between companies from different sectors will not be transformed into M&As.*

A number of studies reveals that the level of technological sophistication of sectors of industry affects the distribution of equity or non-equity modes of strategic technology partnering. According to Harrigan (1985 and 1988) rapid technological change in sectors of industry induces the formation of somewhat informal forms of cooperation such as non-equity agreements. As industries become mature, more formal modes of cooperations such as joint ventures become the preferred form of collaboration. Osborn and Baughn (1990) suggest that technological instability of industrial sectors is a crucial factor in explaining different patterns for equity and non-equity partnerships. R&D intensive sectors with short product-life cycles and an innovative industrial climate are expected to demand more organizational flexibility leading to a general preference for contractual agreements. In sectors with low degrees of R&D intensity and little innovative turbulence where organizational flexibility is also less crucial, technology partnering agreements is expected to be dominated by joint ventures. Yu and Tang's (1992) findings can be

interpreted along similar lines: stable sectoral environments favour joint venture formation, uncertain environments will lead to a larger number of non-equity agreements. Hagedoorn and Narula (1996) also found that technology-intensive sectors are characterized by a vast majority of contractual agreements, whereas the formation of joint ventures accounts for a disproportionate share of technology partnering in medium and low-tech industries. This preference for contractual agreements in technologically advanced sectors and equity oriented cooperation in other sectors suggests that the transformation of strategic technology alliances into M&As could also be unevenly distributed. Turbulent environments would demand in particular short-term contractual agreements with little need for integration of these partners, in other sectors where equity agreements are already more visible the step from an equity agreement to an M&A would be more likely. This line of reasoning follows Oster (1992) who suggests that high-tech industries, characterized by risk and flexibility, favour strategic alliances to M&As, whereas M&As are expected to be more popular in mature sectors. In the present contribution, we analyze this relationship between mode of cooperation and the degree of technological change in sectors with particular reference to new core technologies, such as biotechnology, new materials and information technologies. Following van Tulder and Junne (1988) we expect these new core technologies to present a turbulent high-tech environment demanding new technological competences from companies competing in these fields. Hence:

6 *If the transformation from strategic technology alliances to M&As occurs, the*

share of these transformed strategic technology alliances in new core technologies is disproportionately smaller than the share of the transformed strategic technology alliances in other sectors or fields of technology.

DATA AND METHODOLOGY

In order to find out to what extent strategic technology alliances lead to M&As we combined data from two sources, the MERIT-CATI data bank on strategic technology alliances and the Securities Data data set on M&As. The MERIT-CATI data bank contains data on nearly 13.000 cooperative technology agreements involving about 5.000 parent companies. The information is stored in the form of a relational database whereby its separate data files can be linked to each other in order to provide data in a (dis)aggregate and combined form. Since 1987 data on inter-firm alliances has been systematically collected, including a retrospective search, and the database currently covers the period between 1970 and 1993. The most important data sources are a large number of international and specialized trade and technology journals for each sector of industry and many fields of technology. These journals cover in particular companies from North America, Europe and Asia. Companies' annual reports, the Financial Times' Industrial Companies Yearbooks and Dun and Bradstreet's Who Owns Whom provided information about dissolved equity ventures and investments, as well as ventures that we did not register when surveying alliances.

The database contains information on each cooperative agreement and some information on companies participating in these agreements. Cooperative agreements are

defined as the establishment of common interests between independent (industrial) partners which are not connected through (majority) ownership. The transfer of technology or the undertaking of joint research is considered as crucial to these arrangements. Examples in this respect are joint research pacts and joint development agreements. In addition data are collected on joint ventures with technology sharing or which have a joint R&D program. Mere production or marketing joint ventures are excluded. R&D oriented joint ventures and jointly-owned research corporations are seen as joint ventures, joint development agreements, joint research pacts and research contracts are taken together as contractual agreements.

For the purpose of the present analysis information is used regarding the form of cooperation, the international or domestic character of the alliance, the size of firms involved, the sectors and fields of technology and the year of establishment of the strategic technology alliance. The distribution of firm size is according to employment in five categories (less than 500, 500 to 5.000, 5.000 to 50.000, 50.000 to 150.000, larger than 150.000 employees). Within the CATI database there are 65 classifications with respect to sectors and fields of technology. A major distinction is made between new core technologies (information technologies, biotechnology, new materials) and other industrial sectors. Additional information on this data bank can be found in Hagedoorn (1993) and Hagedoorn and Schakenraad (1994), or obtained from the authors.

The second data bank provides information on M&As. This data bank is property of the firm Securities Data and can be used via on-line access. Currently it contains information on about 125.000 worldwide M&As for the period 1980-1994. This

information is arranged in several data files. For a limited period of time this data base has been accessed and a specific data sample has been extracted. The relational form of the data base facilitates the linking of these data files to each other and also to files in other data banks. Within the M&As data base there is information on the year the M&A got established. In addition, it contains company information on the acquirer, the target, the parent acquirer and the parent target firm. The industry information is provided in SIC codes of the aquiree and acquirer. Unfortunately, the distinction between a merger or an acquisition and a takeover as made by Securities Data does not always correspond to the real background of the M&A. This is partly due to the character of information on M&As in the trade literature. For example, a number of cases has been classified as mergers despite the obvious mismatches in firm-size indicating an acquisition. Acquisitions are frequently presented as mergers because of the negative publicity that acquisitions receive in particular if a foreign partner is involved. Also, the official classification and definition of both modes differs from country to country (Milgrom and Roberts, 1992). As M&As both lead to integration they are taken together and considered as one single category.

For the search procedure that would allow us to find any transition from strategic technology alliances to M&As we have taken the following steps:

- First, a search procedure was developed that would guarantee that all firms involved in strategic technology alliances and M&As in both data banks could be identified. The actual search procedure applied examined the parent companies involved in strategic technology alliances and M&As. This procedure ensures the highest level of corporate control for the analysis with all subsidiaries that are part

of a strategic technology alliance or an M&A being included. This procedure provided us with a population of strategic technology alliances and M&As made by a large group of companies using both modes. In other words, if the transition would take place, it has to show up in this population with firms that are active in both strategic technology alliances and M&As.

- Second, a correspondence in the data fields concerning industry information in both data banks had to be made at the industry level. The technology classification in the CATI data based was adjusted to the SIC code system in the M&As data base using a correspondence table. As a result, the data on cooperative technology alliances within the CATI data bank relevant to the analysis amounted to 6425 strategic technology partnerships. The extracted amount of data from the database on M&As corresponding to the CATI data bank amounted to approximately 16,400 cases. In total about 3000 companies are involved in strategic technology alliances and M&As during the period under consideration.
- Throughout this paper we will discuss alliances, although technically speaking we are analyzing dyads or points of contacts between companies through alliances. In other words, an alliance with more than two partners has several dyads. Also, the first alliance (dyad) between companies as found in our data bank is taken as a point of reference; other alliances between the same partners before an M&A is created (chronologically multiple contacts) are neglected. As such we only analyze whether companies have been acquainted with each other through an initial alliance and then established an M&A.

- Finally, to examine the probability of a transition from strategic technology alliances to M&As, the subset of data extracted from the CATI database is used as the starting point for the analysis. M&As preceding strategic technology alliances between the same partners are neglected as being illogical. In case of an identical announcement year for an alliance and an M&A, we also ignored these because of the high-risk of a misinterpretation of the announcement.

As discussed above, the population of strategic technology alliances under transition was examined with respect to different determinants that could affect this transition. The results of the examination of these different determinants for strategic technology alliances that are actually transformed into M&As are set against the population of non-transformed strategic technology alliances, to compare for different patterns. These non-transformed alliances are the total number of alliances that could have been transformed minus those that actually were minus the chronologically, multiple contacts between the same partners.

The descriptive statistics and simple chi-square tests for differences in the distributions for both populations provide already some answers to some of the questions raised and allow us to already test some hypotheses in a bivariate setting. We will apply logit analysis to test the hypotheses further in a multivariate setting.

EMPIRICAL FINDINGS

Our first finding, and we think also the most remarkable outcome of this research, is that only 2.6% of the total number of strategic technology alliances that we studied could be

linked to M&As. From the total of 6425 strategic technology alliances only 168 cases were linked to M&As of the same partners. If this transition from strategic technology partnership to an M&A took place, this happened within an average period of 6.1 years (with a standard deviation of 4.8).

Table 1 also presents some size-related characteristics of firms involved with strategic technology alliances that have led to M&As of partners. About 38% of the firms involved in this transformation process employ between 5,000 and 50,000 people. The group of large firms with over 50,000 employees has a share of 33.5% of this particular group of alliances. Compared to the distribution of the non-transformed alliances that we searched in this study the distribution for alliances in transition is more skewed as firms with over 5,000 employees have a share of 71.5% against about 30% for all alliances. If we consider the distribution of partners from similar or dissimilar size-categories also involved in an M&A succeeding a strategic technology alliance, we see that two-thirds of these alliances are made between dissimilar companies. For the non-transformed strategic technology alliances the share of companies from different size-classes is significantly higher as about 77% of the partnerships are made between dissimilar firms. A probably more striking result is that of the total number of alliances leading to M&As, only 17% refer to cases where a large or very large company acquires its smaller partner, which is nearly half of the share for non-transformed alliances.

----- insert table 1 about here -----

Data regarding the (inter)national, sectoral and organizational patterns of the groups of strategic technology alliances leading to M&As and the non-transformed strategic technology alliances is presented in table 2. Apparently the distribution of domestic and international alliances comes close to a 45% and 55% distribution for transformed strategic technology alliances and close to a 40% and 60% distribution for the non-transformed population. The chi-square test reveals that there is no significant difference between both distributions.

For the group of transformed alliances we found that about 42% of them are joint ventures, in the group of all other strategic technology alliances the share of joint ventures is about 36%. These findings do not suggest significant differences between both populations in this respect.

If we look at the sectoral background of companies participating in these transitory strategic technology alliances we see that about 73% of them are made by companies from the same sectors compared to 51% for the overall population of strategic technology alliances. The chi-square test reveals that there are significant differences between both distributions.

As far as the distribution of new core technology alliances and other fields of partnering is concerned we see some interesting differences. There is a significant difference between the share for high-tech alliances preceding a take over or merger (59.5%) and the share for the population at large where 67% of the strategic technology alliances are made in new core technologies.

----- insert table 2 about here -----

Given the binary dependent variable, i.e. the occurrence or absence of a transformation of a strategic technology alliance, and the dichotomous nature of the independent variables, i.e. the dimensions of a possible transformation process as discussed above, logit analysis is applied to test the hypotheses in a multivariate setting. There are 6425 observations, with missing data on 2171 cases where the size of partners or the sector could not be identified, see also table 1 and 2. In the remaining sample 153 strategic technology alliances were classified as leading to an M&A, 4101 of them did not. To examine the propensity of strategic technology alliances to lead to M&As, the dependent variable TRANS was introduced (TRANS, transformed alliances = 1, not transformed alliances = 0). The different characteristics of strategic technology alliances in the model are SIZE, INT, SECT, CORE and EQUI. The categorical variable SIZE indicates size differences of firms involved in a strategic technology alliance (SIZE, unequal size = 1, equal size = 0). The variable INT describes the (inter)national patterns of these alliances (INT, international = 1, national = 0). Sectoral and organizational patterns of these alliances are characterized with the categorical variables SECT, CORE and EQUI respectively (CORE, new core technology = 1, non-core technology = 0; SECT, same sector = 1, other sectors = 0; EQUI, equity-based = 1, non-equity based = 0).

In order to analyze which characteristics determine the probabilities that strategic technology alliances lead to M&As, we first applied a simple logit model. The estimation results of the simple logit model are specified in table 3. It is apparent that the

significance level of the model is very low (pseudo $R^2 = 0.04$). A closer look at the analysis shows that from the 4254 cases, 153 were wrongly classified which all belong to the group of strategic technology alliances that were transformed to M&As. Another logit model, constructed to take into account the unbalanced distribution in the sample, generated similar results with respect to significance levels of model and the different variables. In addition, a loglinear analysis of the data did not significantly improve the results either.

----- insert table 3 about here -----

DISCUSSION AND CONCLUSIONS

Our findings indicate that strategic technology partnering plays hardly any direct role when companies form M&As (hypothesis 1). Only in about 2.6% of the relevant strategic technology alliances have these alliances led to an M&A between the same partners. This result is particularly strong as we used two large data sets combining information on over 6000 strategic technology alliances with information on 16,000 M&As of the same group of over 3000 firms.

Our statistical analysis at the bivariate level seems to provide some understanding of this transformation process, but these results have to be seen against the background of the limited relevance that this process apparently has. Concerning the dissimilarity of size-classes of companies that use strategic technology alliances to acquire their partners or merge with them, we found little support for an encroachment thesis with large firms

using their strategic technology alliances to take over their small partners (hypothesis 2b). The role of large firms in taking over their smaller partners is rather limited as this happened in 17% of the cases where strategic technology alliances were transformed into integrated common ownership.

The different variants of logit analysis also demonstrate that the phenomenon of transformation hardly ever takes place and, moreover, it is shown through the extreme low value of the coefficient of determination that the relationships mentioned in the hypotheses have little or no meaning in a multivariate setting. In the few cases where strategic technology partnering is part of a movement towards M&As, it seems this pattern defies the logic that one could deduct from scattered pieces of literature on joint ventures and strategic partnering that point at the relevance of an encroachment strategy. In other words, although some of the hypotheses seem to be confirmed in a bivariate and even in a multivariate setting, a completely different set of relationships and variables seem necessary to explain the behaviour of companies in the context of both strategic technology alliances and M&As.

Before we point at some relevant topics for such an alternative understanding of the relationship between strategic technology alliances and M&As, it is important to stress a possible limitation of this paper. It should be noted that our research pertains to only one specific group of alliances, i.e. those for which the sharing or joint development of new technologies and joint undertaking of R&D is part of the alliance. Therefore, our results could probably have fewer implications for those strategic alliances that are aimed at joint marketing or the sharing of manufacturing or services. However, in recent years

a growing number of contributions (Hagedoorn and Schakenraad, 1994; Osborn and Baughn, 1990; Mowery, 1988; Mytelka, 1991) stress the importance that strategic alliances with a large technology content play in particular in turbulent high-tech industries that will shape much of the present and near-future competitive environment. It is also in these industries that we find a dominance of contractual modes of partnering.

As strategic technology alliances seem to play such a small role in the encroachment of partners, their relevance for company strategies will have to be found somewhere else. An increasing part of the recent literature suggests that strategic technology alliances have to be understood as an important part of a learning process of companies in which they discover new innovative opportunities in a flexible setting of a multitude of partnerships (Ciborra, 1991; Hagedoorn, 1995). Such a learning process in the context of cooperative technological development is of a complicated nature that resembles high-tech learning (Lyles, 1994), exploratory learning (Dodgson, 1993; March, 1991) or double-loop learning (Argyris and Schon, 1978) as it covers a change of routines, unlearning and the discovery of new issues in a joint effort. To some extent the complexity of this learning is due to partner differences (Parkhe, 1991). However, this complexity is at least as much influenced by the exploratory nature of learning in technological development itself, in particular in those industries where technological change is still of a turbulent nature.

Once this learning process of companies changes towards more standard information processing and learning and flexibility become less important for large groups of companies as industries gradually mature, integration through M&As will

probably become a more viable option (Ciborra, 1991). As long as sectors of industry or fields of technology can be characterized as turbulent environments with high technological risk (Ring and van de Ven, 1992) combinations of internal learning and the timely absorption of new technologies through alliances can be more effective than takeovers or mergers of (parts of) companies. In other words, for technological renewal under dynamic-competitive circumstances (Garud, 1994) where knowledge expires quickly, flexible partnering with capable partners might be more adequate than an encroachment strategy leading to formal integration.

A major conclusion from this study appears to be that strategic technology partnering is a different category on its own. In evaluating the impact of strategic decisions in the context of integration versus contracting strategies aimed at improving the innovative capabilities of firms (Teece, 1987) there appears to be little room for transitional strategies as such. Separate modes of partnering, be it of a contractual or an equity nature, have different organizational and strategic properties (Hagedoorn, 1993) but they share their distinctive character that sets them apart from common governance through integration. In that sense, there exists, as far as strategic technology partnering is concerned, and with very few exceptions, no real continuum which suggests that strategic technology partnering is a 'front porch' for corporate growth through integration, by means of M&As.

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Table 1 Company-size related characteristics of strategic technology alliances transformed into mergers and acquisitions, %, 1970-1993

Size distribution	Companies in transformed alliances (n ₁ = 189)*	Companies in all other alliances (n ₂ = 2848)*
< 500 employees	15.0%	42.5%
500 - 5000	13.3%	27.1%
5000 - 50.000	38.2%	24.4%
50.000 - 150.000	23.7%	4.1%
> 150.000	9.8%	1.8%
Total	100%	100%

Alliances with companies of:	Transformed alliances (n ₁ = 168)*	All other alliances (n ₂ =6257)*
similar size	34.6%	23.1%
dissimilar size	65.4%	76.9%
- of which dominated by large firms**	17.0%	33.4%

$X^2=11.4899$; $p < 0.0007$ for distributions of (dis)similar size

* for 173 of companies with transformed alliances the size could be traced, for all other companies the size of 1375 companies could be traced, for transformed alliances the size of partners could be traced for 153 alliances, for all other alliances the size of partners could be identified for 4101 cases

**large firm dominance: combinations of firms >150.000 employees with all companies <50.000 employees; companies with between 50.000 - 150.000 employees with all companies <5.000 employees

Source: MERIT-CATI and Securities Data - M&A

Table 2 International and sectoral patterns in strategic technology alliances transformed into mergers and acquisitions, %, 1970-1993

	Transformed alliances (n ₁ = 168)	All other alliances (n ₂ = 6257)
Domestic alliances	45.8%	40.5%
International alliances	54.2%	59.5%
Total	100%	100%
Joint ventures	41.7%	36.4%
Contractual alliances	58.3%	63.6%
Total	100%	100%
Identical sectors	72.7%	50.8%
Different sectors	27.3%	49.2%
Total*	100%	100%
Core technologies	59.5%	67.1%
Other sectors	40.5%	32.9%
Total	100%	100%

*the actual numbers for the sectoral distribution of alliances are 154 and 4385

(Inter-)national distribution, $X^2 = 1.9478$; $p < 0.1628$

Joint venture distribution, $X^2 = 2.0072$; $p < 0.1566$

Identical sectors distribution, $X^2 = 29.5995$; $p < 0.0000$

Core technologies distribution, $X^2 = 4.3789$; $p < 0.0364$

Source: MERIT-CATI and Securities Data - M&A

Table 3 Results of the logit analysis for the relationship between characteristics of strategic technology alliances and the probability of transformation into M&As

	coef	s.e.
EQUI	0.253	0.169
INT	-0.086	0.172
SECT	-1.023***	0.187
SIZE	-0.459***	0.177
CORE	-0.565***	0.178
Constant	-2.252***	0.226
Observations	4254	
Model likelihood	1267.91	
Pseudo R ²	0.04	

*** p<0.01 (two tailed test of coefficients, one tailed test of likelihood ratio)